SECTION 1
INTRODUCTION

In 2001 the U.S. Environmental Protection Agency (EPA) designed a national network for monitoring air toxics compounds present in ambient air. The objective of this monitoring is to generate ambient air data and to compile these data in an extensive air toxics data base. The use of actual field measurements to compare and reconcile with estimates from source dispersion models will refine the model and ultimately allow a better overall estimate of population exposure. The ultimate goal of this and other parts of EPA's Air Toxics Monitoring Strategy is to fully characterize air toxics impacts and to assess health risks.

The purpose of this technical assistance document (TAD) is to provide guidance to support EPA regional, state, and local agencies responsible for the implementation of this national network, so that consistent high quality data are obtained. The information presented is intended to make recommendations and provide guidelines for approaches to air toxics monitoring that are presently advocated by EPA for application to the National Ambient Air Toxics Trends and Assessment Program.

1.0 AIR TOXICS TRENDS MONITORING NETWORK

A monitoring network to document the concentration of certain air toxics on a national scale is being developed to achieve EPA's trends assessment objectives. Data from EPA's national monitoring activities will establish an estimate of national average concentrations for these air toxics compounds, allow EPA to evaluate the need for new National Ambient Air Quality Standards (NAAQSs), and establish associated limits.

Data from sites in this trends network will be used to identify the probability that long-term changes or trends in ambient air concentrations are occurring. Using this information, EPA, states, and local agencies can estimate changes in the risks of human exposure. These

changes can then be used to anticipate changes in environmental policy and to establish a regulatory stance.

As part of the overall National Air Toxics Assessment (NATA) process, ambient air quality data are important to help assess the national toxics inventory and long-term hazardous air pollutant (HAP) trends. NATA activities are focused on providing the best technical information regarding air toxics emissions, ambient concentrations, and health and environmental impacts to support the development of sound policies in the national air toxics program. NATA activities encompass the following:

- Measurement of air toxics emission rates from individual pollution sources;
- Compilation of comprehensive air toxics emission inventories for local, state, and national domains;
- Measurement of ambient concentrations of air toxics at monitoring sites throughout the nation;
- Analysis of patterns and trends in ambient air toxics measurements;
- Estimation of ambient and multimedia air toxics concentrations from emission inventories using dispersion and deposition modeling;
- Estimation of human and environmental exposure to air toxics;
- Assessment of human and environmental risks due to air toxics; and
- Ongoing research to improve assessments over time.

The wide range of NATA activities listed above illustrates that emissions data, ambient concentration measurements, modeled estimates, and health and environmental impact assessments are all needed to fully characterize air toxics impacts and to determine risk. Specific types of data are needed:

- Emissions data are needed to quantify the sources of air toxics impacts and aid in the development of control strategies;
- Ambient monitoring data are needed to characterize air toxics ambient concentrations and toxics deposition, to better understand the fate and transport of air toxics in the atmosphere, and to help evaluate atmospheric dispersion and deposition models;
- Modeled estimates are needed to extrapolate our knowledge of air toxics impacts into locations without monitors since ambient measurements cannot practically be made everywhere;
- Exposure assessment information and health effects information need to be integrated in order to characterize air toxics risks; and
- Ambient measurements provided from routine monitoring programs together with personal exposure measurements, which currently can be obtained from ongoing research studies are important for evaluation of air quality and exposure models.

Creation of satellite monitoring sites using identical monitoring approaches to the National Air Toxics Trends Monitoring Stations (NATTS) but at locations other than the NATTS monitoring sites is envisioned by establishing partnership with state and local agencies. For example, urban sites identified as high risk (such as schools located near HAP emission sources or urban sites located in the persistent downwind direction from high activity areas) might use NATTS monitoring approaches to quantify ambient conditions in the vicinity of these localized “hot spots.”

1.1 DATA CONSISTENCY

The objective of the NATTS is to successfully detect trends in HAPs concentrations with uniform certainty across the national set of monitoring sites, at the targeted level (i.e., a coefficient of variation of 15% over a period of three years). Using a 1-in-6-day monitoring frequency, the monitoring approach must show a combination of precision, accuracy, and sensitivity appropriate for the concentration ranges at a set of fixed monitoring sites each selected with consistent siting criteria. With the exception of acrolein, this level of performance

is currently substantiated for a limited number of HAPs that have been monitored successfully over several years. These HAPs have National Institute of Standards and Technology (NIST)-based calibration standards or equivalent and have standardized monitoring calibration procedures. Therefore, to ensure the success of the NATTS, the initial set of compounds to be monitored excludes some HAPs. This conservative approach essentially guarantees success in meeting the program objective for the selected HAPs but excludes some high risk HAPs. Review of the status of methods at intervals in the future will be used to determine the prospect of adding HAPs in subsequent stages of the NATTS.

Currently, 188 HAPs are regulated under the Clean Air Act (CAA). Air emissions of these HAPs may cause a wide variety of adverse ecosystem and health problems, including cancer, neurological effects, reproductive effects and developmental effects. Emissions from multiple sources, including major stationary, area, and mobile sources, result in population exposure to these air toxics compounds. In some cases the public may be exposed to an individual HAP. More typically, however, people experience exposures to multiple HAPs from many sources. Exposures result not only from the direct inhalation of HAPs, but also from multipathway exposures such as drinking water contaminated from airborne deposition of HAP-laden particles, deposition on skin, various routes to ingestion in contaminated food, etc. Since this document addresses an ambient air monitoring program, the focus is on airborne HAPs.

1.2 GPRA GOALS AND TRENDS MONITORING

EPA's current Government Performance Results Act (GPRA) commitments specify a goal of reducing air toxics emissions by 75% from 1993 levels in order to significantly reduce the risk of cancer and other serious adverse health effects caused by airborne toxics. That goal will be modified to focus on risk reductions associated with exposure to air toxics as new data and tools become available[1]. By the year 2020, EPA's goal is to eliminate unacceptable risks of cancer and other significant health problems from air toxic emissions for at least 95% of the population (relative to the population at the time of interest), with particular attention to children

and other sensitive subpopulations, and substantially reduce or eliminate adverse effects on our natural environment.[2] No one specific level of risk is "unacceptable." Acceptability of risk is influenced by many factors. EPA identified lifetime excess risks of cancer of 100 in a million as being the upper end of the range of acceptable risk. Typically, the EPA treats environmental risks (either from a single source type or from a pollutant in an environmental medium) of 1 in a million or less as not being of regulatory concern. To evaluate progress toward EPA's goals, the first priority is to establish a baseline—what are air toxics levels *now*?—against which progress can be measured as successive years of monitoring data become available.

1.3 HEALTH RISK ASSESSMENT AND AIR TOXICS COMPOUNDS

EPA's ultimate goal is to eliminate unacceptable risks of cancer and other significant health problems from exposures to air toxics emissions and to substantially reduce or eliminate adverse effects on our natural environment. To provide a basis for decision making with respect to these matters, a NATTS network is being developed.

To make progress toward this risk-based goal, EPA will focus on:

- The cumulative health and ecosystem risks inherent in modern urban and rural living;
- The multimedia effects of air toxics on water bodies in which water quality and aquatic life are affected by the deposition of persistent and bioaccumulating air toxics;
- The multimedia effects of persistent air toxics deposition to soil (e.g., lead, dioxins); and
- The effects on sensitive populations and on economically disadvantaged communities. Are economically disadvantaged communities at a higher level of risk (i.e., more exposure, higher levels of exposure) than other types of communities?

1.4 STATE AND REGIONAL MONITORING GOALS

Ongoing and past regional, state, and local monitoring efforts have performed a twofold mission in ambient air toxics programs. First, existing monitoring sites have been selected to assess exposure and ambient air quality issues important to local communities. Local and regional goals have often focused on evaluation of exposure of particular groups of people to localized sources of HAPs. Second, the monitoring techniques used by these sites and the data generated through these monitoring programs also provide the basis for selection of a permanent, long-term national ambient air quality monitoring network.

1.5 EPA'S AIR TOXICS PROGRAMS: EXPOSURE/RISK EVALUATION AND TRENDS ANALYSIS

In 1987, EPA developed the Urban Air Toxics Monitoring Program (UATMP) to help state and local agencies characterize the nature and distribution of potentially toxic air pollution in urban areas. The original intent of the UATMP was to screen ambient air samples for concentrations of toxic volatile organic compounds that could cause adverse human health effects. Since 1987, several state and local agencies have participated in the UATMP by implementing ambient air monitoring programs. These efforts have helped to identify the toxic compounds most prevalent in the ambient air and emissions sources likely to contribute to elevated concentrations. As a screening program, the UATMP also provides data input for models used by EPA, state, and local personnel to assess risks posed by the presence of toxic compounds in urban areas. The UATMP is a year-round sampling program, collecting 24-hour integrated ambient air samples every 12 days at urban sites in the contiguous United States.

In 1999, the EPA expanded the UATMP to provide for the measurement of additional HAPs to support GPRA. EPA and the states initiated pilot studies to determine the best candidate sites for a long-term air toxics monitoring network. The data obtained using a single, consistent approach for toxic monitoring and a comprehensive, program-specific Quality

Assurance Project Plan (QAPP) allow EPA, state, and local risk assessors to evaluate the prevalence, concentration and trends for air toxics compounds in the urban air. The data collected continuously over a period of years produce consistent results for use by data analysts. Meeting method specifications with consistent approaches to sampling and analysis yields consistent and defensible data.

1.6 REASONS FOR CONDUCTING A MONITORING PROGRAM

To address the concerns posed by air toxics emissions and to meet strategic goals, EPA has developed a National Air Toxics Program designed to characterize, prioritize, and address the impacts of HAPs on the public health and the environment. The National Air Toxics Program seeks to address air toxics problems through a strategic combination of several agencies' activities and authorities, including regulatory approaches and voluntary partnerships. EPA envisions four key areas of activities:

- Source-specific standards and sector-based standards, including Section 112 standards, i.e., Maximum Achievable Control Technology (MACT), Generally Achievable Control Technology (GACT), residual risk standards, and Section 129 standards.
- National, regional, and community-based initiatives to focus on multimedia and cumulative risks, such as the Integrated Urban Air Toxics Strategy, Great Waters and National Estuary Program, Mercury Initiatives, Persistent Bioaccumulative Toxics (PBT) and Total Maximum Daily Load (TMDL) Initiatives, and Clean Air Partnerships.
- NATA activities to help EPA identify areas of concern, characterize human health and ecosystem risks and track progress. These activities include expanded air toxics monitoring, improving and periodically updating emissions inventories, national- and local-scale air quality and exposure modeling, and continued research on effects and assessment tools. These efforts will lead to improved characterizations of air toxics risk and reductions in risk resulting from ongoing and future implementation of air toxics emissions control standards and initiatives.

- Public education and outreach to focus public attention on the NATA activities. Application of a consistent program that maintains established standards for monitoring quality and performance will be critical to the success of all the other major areas of activities within the National Air Toxics Program.

1.7 NATA AND THE ROLE OF AMBIENT MONITORING

A key component for the air toxics monitoring network is the designation of HAPs that will be measured. It is not practical to measure all HAPs at all locations. Recognizing the practical limitations on air toxics regulatory programs, the CAA amendments required EPA to develop a subset of the 188 toxics identified in Section 112 with the greatest impact on the public and the environment in urban areas. This subset of the 188 air toxics consists of the 33 HAPs identified in the Integrated Urban Air Toxics Strategy (UATS)[3] commonly referred to as the "Urban HAP List." Because this Urban HAP List was developed to reflect a variety of possible exposure periods (acute/chronic), pathways (inhalation, dermal, ingestion), and types of adverse health effects (cancer/noncancer), the toxics monitoring network should attempt to address the full Urban HAP List. Considering the chemical properties of these HAPs, they can be grouped into several general categories, including volatile organic compounds (VOCs), metals, carbonyl compounds, and semivolatile organic compounds (SVOCs).

From the Urban HAP List of 33 HAPs, candidates for the NATTS Program were selected and are presented in Table 1.1-1. Six of the 20 entries in Table 1.1-1 must be monitored from the initiation of NATTS because these entries are the major risk drivers based on a relative ranking performed by EPA. The remaining 14 entries must be reported to NATTS if the corresponding methods are being conducted at the site.

1.8 SITE CONSIDERATIONS

Information on air toxics compounds is needed for both urban and rural areas. Urban-oriented information is needed to address the range of population exposures across and within urban areas, whereas rural data are needed for characterization of exposures of nonurban

populations, to establish background concentrations and to better assess environmental impacts. The monitoring sites needed to accomplish NATTS Program goals must emphasize long-term measures of air quality. NATTS Program monitoring data must focus on long-term, year-round information. Therefore, NATTS Program participants must use monitoring sites established and maintained in the same location and collect data year-round for many years using the methods and frequency guidelines specified in this TAD. For manual sampling, the default frequency for sample collection at NATTS Program collection locations is one sample every six days, as determined by the requirements of the NATTS data quality objectives (DQOs).

1.9 THE NATTS PILOT PROJECTS

The success of the NATTS Program depends critically on EPA's ability to understand and quantify the impacts of air toxics emissions on public health and the environment. To that end, EPA has already initiated numerous NATTS Program activities. All of these activities are aimed at providing the best current technical information regarding air toxics emissions, ambient concentrations, and health and environmental impacts to support the development of sound policies for a National Air Toxics Program. Specifically, ambient monitoring data are needed to characterize air toxics ambient concentrations and toxics deposition to better understand the fate and transport of air toxics in the atmosphere and to help evaluate atmospheric dispersion and deposition models. Because it is impractical to monitor everywhere, modeled estimates are needed to extrapolate knowledge of air toxics impacts into locations without monitoring. A combination of reliable modeling systems along with well-designed ambient networks is the best approach for estimating ambient concentrations and population/ecosystem exposure across the nation.

Table 1.1-1. NATTS Monitoring Requirements

NATTS Year 1 **These monitoring requirements must be implemented from the initiation of NATTS monitoring because these compounds are the major risk drivers.**		
Monitored	**Method**	**UATMP Element[3]**
benzene	TO-15	yes
1,3-butadiene	TO-15	yes
arsenic (As) compounds	IO-3.5	yes
hexavalent chromium (Cr^{+6})	Research Method	yes
formaldehyde	TO-11A	yes
acrolein[1]	Research Method	no
NATTS **VOCs listed below must be reported and considered as NATTS compounds if Method TO-15 is being applied. Metals must be reported and considered as NATTS elements if Method IO-3.5 is being applied. Carbonyl Compounds listed below must be reported and considered as NATTS compounds if Method TO-11A is being Applied.**		
VOCs		
carbon tetrachloride	TO-15	yes
chloroform	TO-15	yes
1,2-dichloropropane (propylene dichloride)	TO-15	yes
methylene chloride (dichloromethane)	TO-15	yes
Tetrachloroethylene (perchloroethylene, PCE)	TO-15	yes
trichloroethylene (TCE)	TO-15	yes
vinyl chloride	TO-15	yes
Metals		
beryllium (Be) and compounds	IO-3.5	yes
cadmium (Cd) and compounds	IO-3.5	yes
chromium (Cr) and compounds[2]	IO-3.5	yes
lead (Pb) and compounds	IO-3.5	yes
manganese (Mn) and compounds	IO-3.5	yes
nickel (Ni) and compounds	IO-3.5	yes
Carbonyl Compounds		
acetaldehyde	TO-11A	yes

[1] Modifications to the TO-11A methodology being evaluated. Sampling and analytical methodology using dansylhydrazine as a derivatizing reagent also being evaluated.
[2] Method IO-3.5 measures Total Chromium only; determination of hexavalent chromium requires a specialized sampling and analytical methodology.
[3] Accepted sampling and analytical methodology is presently available through EPA's UATMP.

EPA and its state and local partners have developed and implemented pilot toxics monitoring (TM) projects as an element of the NATTS Program.[4] The pilot TM projects were designed:

- To refine monitoring approaches;
- To provide data to allow determination of DQOs for NATTS; and
- To characterize, prioritize, and address the impacts of HAPs on the public health and the environment.

The pilot TM projects typically include multiple sites in a localized network. EPA strives to establish the ability to better define residual risks and determine the additional controls that may be needed to address toxic pollutant emissions. This better definition is being addressed through the continuing development of the National Toxics Inventory and added emphasis on air toxics monitoring.

The pilot TM projects were comprised of four key elements:

- Source and sector based standards;
- National, regional, and community-based initiatives focused on multimedia and cumulative risks;
- Ongoing education and outreach; and
- NATAs.

NATAs are intended to help identify key areas of concern and track performance. Assessment activities include:

- Expanded air toxics monitoring;
- Improving and periodically updating emissions inventories;

- Multilevel air quality and exposure modeling; and
- Continued research on effects and assessment tools.

The specific objectives of the pilot TM projects were as follows:

- To provide a data base sufficient to optimize the implementation of the NATTS Program;
- To characterize pollution gradients reflecting diverse population areas and a variety of emission sources;
- To provide information on concentration levels and pollutant type variability to compare with model outputs;
- To obtain data to determine the number of sites and the collection frequency (see Section 3.1.1, Attachment 3.1, for a discussion of collection frequency) required to appropriately characterize the state of air toxics pollution in individual urban areas; and
- To determine the range of concentrations that may be expected in differing urban/rural environments and source influences (i.e., mobile sources, industrial activity, normal background, etc.).

In addition, initial new monitoring together with data analysis from existing measurements will be needed to provide a sufficient understanding of ambient air toxics concentrations throughout the country in order to decide on the appropriate quantity and quality of needed data.

1.10 SHORT SUMMARY OF EACH SUBSEQUENT CHAPTER

The remainder of this technical assistance document incorporates the following sections:

- “Issues Concerning Establishment of a Trends Network” (Section 2) includes guidance and rationale for consistency in site selection, sample collection and

analysis procedures to ensure that DQOs for exposure assessment and trends are met.

- "Guidelines for Development of Monitoring Quality Assurance Systems" (Section 3) includes the general approach and specific requirements for consistency in the quality control (QC) and quality assurance (QA) recommended for the NATTS monitoring. Specific method quality objectives (MQOs) are provided for sample analysis procedures as criteria for performance-based methodology.

- "Measurement Methods" (Section 4) describes the consistent application of EPA advocated methods for the collection and analysis of NATTS Program samples.

- "Data Validation and Management" (Section 5) provides guidance for data review and consistency. This section provides information and guidance on procedures to ensure data are consistent, validated, reported, archived and entered into the Air Quality Subsystem (AQS) data base in a consistent and equivalent manner for each of the participating NATTS participants.

Section 1
References and Resources

1. Peer Review Draft for the Science Advisory Committee, Air Toxics Monitoring Strategy Subcommittee FY-00. Air Toxics Monitoring Concept Paper. February 29, 2000. Available at http://www.epa.gov/ttn/amtic/files/ambient/airtox/cncp-sab.pdf

2. Final FY 2003 Technical Program Guidance; U.S. Environmental Protection Agency, Office of Air and Radiation, May 6, 2002.

3. Smith, R.L.; French, C.L.; Murphy, D.L.; Thompson, R. *Selection of HAPs Under Section 112(k) of the Clean Air Act: Technical Support Document*; Integrated Urban Air Toxics Strategy (UATS), July 28, 1999.

4. *Pilot City Air Toxics Measurements Summary*; EPA454/R-01-003; U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. Available at http://www.epa.gov/ttnamti1/files/ambient/airtox/toxics2a.pdf